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AROUSAL AND LOGICAL INFERENCE.

BY- KOEN, FRANK
MICHIGAN UNIV., ANN ARBOR,CTR.FOR RES.LANG.AND BEH

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THE PURPOSE OF THE EXPERIMENT WAS TO DETERMINE THE DEGREE TO WHICH PHYSIOLOGICAL AROUSAL, AS INDEXED BY THE GRASON STADLER TYPE OPERANT CONDITIONING APPARATUS (GSR), IS RELATED TO THE ACCURACY OF LOGICAL REASONING. THE STIMULI WERE 12 SYLLOGISMS, THREE OF EACH OF FOUR DIFFERENT LOGICAL FORMS. THE 14 SUBJECTS (SS) INDICATED THEIR AGREEMENT OR DISAGREEMENT WITH EACH OF THE PREMISES AND WITH THE CONCLUSION OF EACH SYLLOGISM, WHILE CONTINUOUS GSR RECORDINGS WERE TAKEN. NO RELATION BETWEEN GSR AND ACCURACY OF LOGICAL INFERENCE WAS FOUND. HOWEVER, PERSONAL OPINION APPEARS TO BE SIGNIFICANTLY RELATED TO SUCH JUDGMENTS. IF S AGREES WITH AN ITEM AND DECLARES IT VALID, OR DISAGREES WITH IT AND CALLS IT INVALID, SHE IS MORE LIKELY TO BE LOGICALLY INCORRECT THAN IF HER OPINION AND HER JUDGMENT OF VALIDITY WERE NOT CONGRUENT. THIS RESEARCH REPORT IS ONE OF SEVERAL WHICH HAVE BEEN SUBMITTED TO THE OFFICE OF EDUCATION AS "STUDIES IN LANGUAGE AND LANGUAGE BEHAVIOR," PROGRESS REPORT 5, SEPTEMBER 1, 1967. (AUTHOR)

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Arousal and Logical Inference[1]

Frank Koen

Center for Research on Language and Language Behavior
The University of Michigan

The purpose of the experiment was to determine the degree to which physiological arousal, as indexed by GSR, is related to the accuracy of logical reasoning. The stimuli were 12 syllogisms, 3 of each of 4 different logical forms. 14 Ss indicated their agreement or disagreement with each of the premises and with the conclusion of each syllogism, while continuous GSR recordings were taken. No relation between GSR and accuracy of logical inference was found. However, personal opinion appears to be significantly related to such judgments. If S agrees with an item and declares it valid, or disagrees with it and calls it invalid, she is more likely to be logically incorrect than if her opinion and her judgment of validity were not congruent.

Previous research has shown that logical reasoning processes are subject to distortion under the influence of an individual's attitudes and values; reasoning is more accurate when dealing with affectively neutral content. For example, Thistlethwaite (1959) obtained scores from college students in the North, South, and West on the ethnocentrism scale and the anti-Negro subscale of Sanford's F-test (Adorno, Frenkel-Brunswik, Levinson, & Sanford, 1950).

He then had Ss make judgments of the validity of neutral and emotionally toned arguments whose content dealt with minority groups. With logical form held constant, there was a positive relation between scores on the ethnocentrism measures and the number of errors as Ss moved from neutral to emotionally "loaded" arguments. Similarly, Shelley and Davis (1957), using Thistlethwaite's (1959) items, found that Ss with high F-scale scores made significantly more reasoning errors on emotionally toned than on neutral arguments.

Finally, Thouless (1959) made more specific the relation between attitudes and reasoning errors. Using syllogisms as stimuli, he found that Ss tend to judge an argument logically "sound" if they agree with the conclusion, and "unsound" if they disagree. He had Ss read the conclusion "while ignoring the rest of the argument" and indicate whether they thought the proposition contained therein was true or false in their opinion. Assuming that the premises were true, they then made judgments of the validity of the entire argument. Conclusions with which we happen to agree tend to be seen as logically valid.

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Another group of experiments has explored the relation between autonomic responses, including GSR, and personal attitudes. Cooper and Siegel (1956), and Westie and DeFleur (1959) found positive correlations between GSR and the intensity of negative attitudes toward various ethnic groups. In both experiments, Ss were identified as "prejudiced" or "non-prejudiced" on the basis of their responses to ethnic rating scales. Then GSR measures were obtained to verbal or pictorial stimuli. In both cases, significantly greater responses were obtained from "prejudiced" Ss. It is to be noted that there is no parallel data relating positive affect associated with attitudes and GSR.

On the basis of these two lines of investigation, it is reasonable to speculate as follows. If GSR reflects the strength with which attitudes and opinions are held, and if such opinions are associated with an increase in the number of logical reasoning errors that occur when a S must deal with emotionally toned material, then it may well be the case that any material which elicits high GSRs in a given individual will also give rise to more reasoning errors than will material of a less arousing nature. In addition, perhaps the relation between personal opinions and reasoning errors is a little more complex than has been previously supposed. The studies mentioned above have measured Ss' attitudes and opinions toward only the conclusions of logical arguments. Of course, it is possible for an individual to agree with some elements of an argument while disagreeing with others. Perhaps consistent agreement (disagreement) with both premises and the conclusion of a syllogism will heighten the distortion effect, while mixed opinions may tend to mitigate it.

The present study is designed to answer two general questions. First, what is the relation between arousal as measured by GSR and reasoning accuracy? Second, do opinions toward the premises of an argument influence judgments of validity?

Method

Subjects. All Ss were paid female undergraduate volunteers, except in pretests designed to establish the difficulty of the logical forms and in the test used to establish the emotional tone of the stimulus items. In these cases, the sex of the Ss was a random mix.

Stimuli. Sixteen syllogisms were composed, each of a different logical form; one-half were logically valid, one-half invalid. They were presented to 19 pre-

test Ss who had had no formal courses in logic in counterbalanced order in both symbolic (i.e., If p is the case, then q is the case) and in translated terms (i.e., If a person is a member of Phi Delta Kappa, he is a college student). Each syllogism consisted of two premises and a conclusion. Ss were instructed to indicate their personal agreement(disagreement) with each of the three sentences in each syllogism, then to judge the validity of the argument as a whole. Four forms were chosen (one invalid and three valid) which had been judged correctly (in translated form) by 11 to 14 of the 19 Ss. The 12 arguments were then put on 2 x 2 in. slides. Each argument consisted of four slides, one for each premise and for the conclusion; the fourth contained the entire argument.

Here is one of the three invalid arguments:

1. Klan beatings of niggers in the South go unpunished and these beatings are administered with rods that are covered with rags.

2. Of course, Klansmen's chances of going unpunished depend on their leaving the nigger unmarked.

Obviously then,

3. so long as they put plenty of rags on their rods before they begin, they can fix the nigger good without leaving marks.

One of the nine valid arguments is:

1. Any time that love is mutual it is always long-lasting.

2. A characteristic of truly durable love is that it is given without reservation.

So you can be sure that

3. if you attach any reservations to your love, it will not be mutual.

Apparatus. The slides were projected by a Kodak Carousel Model 800 projector, which was controlled by an automatic timing mechanism. This train consisted of a locally produced pulse generator which fed signals into a Grason-Stadler Type E783B Operant Conditioning Apparatus and a Grason-Stadler Power Supply, Model E1100D. Electrodes and paste were the same as those described in Kleinsmith and Kaplan (1964). The GSR apparatus was a Feis Dermohmeter Model 22A. Slide changes, A-D responses, and continuous GSR values were recorded on a Honeywell Visicorder Model 1508. Ss registered degree of agreement (A) or disagreement (D) by moving the handle of a locally fabricated spring-loaded potentiometer, hereinafter referred to as the "A-D meter."

Pre-test to establish exposure times. Data were collected individually from each of ten Ss. Electrodes were attached to the first and third fingers of the left hand. After familiarization with the apparatus and with the kinds of responses which would be required, S was isolated in a booth and the door was closed. All further communication was by intercom. Instructions called for S to read each sentence aloud as it was projected and to indicate by means of the A-D meter her degree of agreement or disagreement with the content, then to indicate verbally when she was ready for the next slide. At slide 4 of the argument, she was to make a judgment as to the validity of the argument as a whole, independent of her opinions of its constituents. Thirteen practice items and 12 experimental items were presented in random order to each S. Exposure time for each slide was determined by S's response. Exposure times for each slide, A-D responses and GSR were recorded on the Visicorder. Between each pair of arguments, S named the colors of a slide consisting of nine circular spots of color; the time was also recorded. The mean exposure times for first, second, and third sentences, for total argument and for color slides were determined.

Experimental procedures. Each of 18 Ss served individually. The S was introduced to the apparatus, the functions of the various components were explained, electrodes were attached to the first and third fingers of the left hand, she was seated in a soundproof booth and the door was closed. Instructions were read over an intercom. S was trained in the task with three self-paced illustrative items; E explained ambiguities and corrected deviant responses. Then the automatic timing mechanism took over control of the presentation of stimuli--four practice items, followed immediately by the 12 experimental items in one of four different random orders. During this sequence, the first sentence of a syllogism was projected on a screen on the front wall of the booth for 15 sec., and S registered the direction and intensity of her opinion of the content by moving the handle of the A-D meter. Instructions called for S to move the handle to the left to indicate disagreement with what the sentence said, and to the right to indicate agreement, with the strength of her opinion reflected by the amount of movement in either direction. The second sentence was then projected for 15 sec.; the third for 16 sec. A fourth slide containing the entire argument was projected for 45 sec., during which time S stated her judgment of the validity

of the item. The next slide projected nine colored circles, which S had to name. This slide was shown for 12 sec., and was immediately followed by the first sentence of the next item. Slide changes, GSR, and A-D responses were recorded automatically on the four-channel Visicorder; E recorded validity judgments.

Results and Discussion

The data for four Ss could not be analyzed due to artifacts in the GSR records; results will be reported in terms of the remaining 14 Ss.

GSR records were scored as per cent deflection from the basal resistance level--the absolute resistance immediately preceding a change. Rises in resistance were scored as negative arousal; no GSR was scored if the change began less than 3 sec. before the end of the exposure period of the item. Since exposure times were quite regular, Ss could easily anticipate them and hence show a resistance drop to the slide change rather than to the content of the items. A-D data were scored in 11 categories, from -5 for maximum disagreement to +5 for maximum agreement.

For each S, the group of three arguments of the same logical form was divided into the one which elicited the greatest GSR to slide 4 (the one in view while S was making her decision about validity), the argument eliciting the smallest GSR to slide 4, and the one which fell between. Thus there were four "high GSR" arguments, four mediums, and four lows, for each S. Most errors in logical reasoning were expected in the high group, and fewest in the low group. It can be seen in Table 1 that the prediction was not confirmed. A repeated

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Insert Table 1 about here

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measures analysis of variance found no significant differences between arousal levels or between Ss. Similarly, an analysis of errors in terms of the four items associated with high GSR for each S, regardless of logical form revealed no significant differences in comparison with the four with the lowest arousal.

The average GSR in terms of per cent reduction in basal resistance level and the number of correct validity judgments for each argument are shown in Table 2. It can be seen that the connection between arousal and accuracy of logical reasoning is very slight.

Insert Table 2 about here

Is there a tendency to call arguments with which one agrees "valid" and those with which one disagrees "invalid?" In studying this question, an opinion was considered "congruent" with the judgment of a valid argument if S indicated agreement with the content of a sentence and judged the argument valid, or if her opinion was contrary to an item which she judged to be invalid. In this sense, across all sentences and all Ss, 38% of the A-D judgments and validity decisions were congruent. Of these, 58% of the validity judgments were logically correct; for sentences in which A-D judgments were incongruent with validity, 79% of the validity judgments of the associated items were correct. A t-test for correlated data shows the difference to be significant at the .05 level ($t = 2.34$, $df = 13$, two-tailed test). This tendency of Ss to call arguments "valid" if they agree with the content of the constituent sentences confirms the results of earlier studies (e.g., Thouless, 1959).

Previous research has investigated bias associated with personal opinions related only to the conclusions of syllogisms. An analysis of the results in terms of each of the premises independently as well as the conclusion shows them to be completely consistent. There was some indication that the effect of personal opinion on validity judgments is particularly associated with a congruent condition in the first premise--e.g., agreement with the content of the first premise is more often connected with incorrect validity judgments than is agreement with the second premise or the conclusion. However, the differences are not significant. Furthermore, there is no change in bias (in validity judgments) associated with "homogeneous" opinions (the same opinion--agreement or disagreement--indicated toward all three sentences of the item) as compared with "heterogeneous" opinions, in which one or more sentences were agreed with while there was disagreement with the remainder.

In general, there is little relation between GSR and A-D responses. The two variables were correlated separately for each S; the average correlation is less than .10. The present study provides only partial confirmation of the results of previous research. It is entirely possible that the intensity of the emotional responses elicited was not sufficient to disturb reasoning processes. Previous studies have made use of information about Ss which presumably tapped much deeper personal convictions. It is doubtful whether any S in the present experiment became much involved in the arguments presented as stimuli.

In addition, the atmosphere in which the experiment was conducted was quite different from that of earlier studies--tending to create much more of the aura of "laboratory science" with its implicit cognitive orientation rather than giving rein to personal feelings.

Two general interpretations of the GSR results appear to be appropriate at this point. First, the arousal associated with personal feelings may well be conducive to errors in logical reasoning but the personal relevance of the content is probably an important determinant of Ss' reactions. Second, at least with the degrees of arousal elicited here, Ss appear to be able to control irrational responses which tend to be associated with physiological lability.

On the other hand, publicly expressed opinion about the content of an argument seems related to the accuracy of logical judgment, in the sense that the desire on the part of Ss to make judgments consonant with their personal opinions appears greater than that to follow rigorously the logic of the argument. Perhaps the results are not due to an inability to separate opinion and judgment, but to setting a greater value on consistency relative to the former. This may amount to a value decision in which less internal dissonance is anticipated by making "logical" judgments consistent with one's own previous public statements than by asserting one kind of opinion, then making judgments "contrary" to it. To take issue with the factual basis of a group of statements, then accept the argument they make may, in some sense, reflect on the perspicacity and appropriateness of the opinions.

If a tendency to seek personal consistency (or perhaps to reduce cognitive dissonance) is an important variable in such situations, the question can be studied in the following manner. One group of Ss would first make validity judgments of a group of syllogisms, then state their opinions of the factual truth or falsity of the constituent statements. A second group would serve under the same conditions, but in the reverse order. It is possible that, so long as S remembers his validity judgment, his publicly stated opinions may tend to conform to it rather than the reverse, as has been commonly found. Such an experiment might indicate whether the desire to maintain personal consistency is an important variable in studies like those of Thistlethwaite (1950), Shelley and Davis (1957) and Thouless (1959), as well as the present one. Such speculation is entirely consistent with the results in all four cases.

If such were to prove the case, a further prediction can be made. Individuals with relatively "closed" minds (Rokeach, 1960) should show a greater tendency toward consistency between validity judgments and personal opinions than more open-minded Ss.

Footnote

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Table 1

Correct Validity Judgments per Subject at Each of Three Levels of Arousal (GSR)

	High	Medium	Low
Mean	2.86	2.43	3.00
S.D.	.86	.64	.88

Table 2

Average GSR and Number of Correct Validity Judgments Associated with Each Experimental Item

Item No.	GSR	Correct	Item No.	GSR	Correct	Item No.	GSR	Correct	Item No.	GSR	Correct
218	4.6*	11	318	2.7	10	424	3.8	5	602	2.3	11
221	7.2	14	323	6.9	12	426	1.8	11	606	3.7	12
227	4.4	9	327	2.7	6	428	1.3	12	615	5.5	3

*Figure is per cent drop from immediately preceding resistance level.